Chapter 10

Formation of Cenozoic Carbonates

According to sedimentologist, Francis Pettijohn, carbonates make up about 8% of all sedimentary rocks.[1] Carbonates are mostly limestone ($CaCO_3$) and dolomite ($CaMgCO_3$) which are chemicals that precipitate out of water or are the remains of organisms that had a carbonate shell. Carbonates are abundant in the Paleozoic and late Precambrian and decrease upward in the geological column.

The Cenozoic consists mostly of basin and local to regional sedimentary rocks, mainly sandstones, shales, conglomerates, and various volcanic rocks. Carbonates are not particularly rare in the Cenozoic, and some are relatively thick and pure.

Early Cenozoic Carbonates

The early Cenozoic is defined as the Paleocene, Eocene, and Oligocene. It has areas of widespread carbonate rocks on the continents.[2] In North America, all of Florida is covered by Early Cenozoic carbonate. In Central America, the Yucatan Peninsula is mostly early Cenozoic carbonate. In the Eastern Hemisphere, Saudi Arabia has large areas of early Cenozoic carbonates and larger areas are found in West Africa, East Africa, around the Mediterranean Sea, southwestern Russia, and the Ukraine.

Late Cenozoic Carbonates

Only the Miocene and Pliocene of the late Cenozoic distributions of continental carbonate will be discussed.[3] Widespread Miocene carbonates are found in the Caribbean Islands and the southeast United States in the Western Hemisphere. Miocene carbonates are also found around the Mediterranean Sea, southwest Russia, and the Ukraine, but they are patchier than in the early Cenozoic. Some significant Miocene carbonates show up in Indonesia and southern Australia, as in the very flat Nullarbor Plain of South Australia covering 78, 000 mi^2 (200,000 km^2).[4] There does not appear to be any significantly sized carbonates during the Pliocene.

The Hualapai Limestone in the Lake Mead Area

I will give one small example in the western United States. The Hualapai Limestone Member is the top member of the Muddy Creek Formation of southeast Nevada and northwest Arizona.[5] It is a basin-fill sediment deposited after uplift of the mountains.[6] It recently has been named the

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[1] Pettijohn, F.J., 1975. *Sedimentary Rocks*, third edition, Harper and Row, New York, NY, p. 22.
[2] Ronov, A.B., Khain, V.Ye., and Balukhovskiy, A.N., 1979. Paleogene lithologic associations of the continents. *International Geology Review* 21(4):415–446.
[3] Khain, V.Ye., Ronov, A.B., and Balukhovskiy, A.N., 1981. Neogene lithologic associations of the continents. *International Geology Review* 23(4):426–454.
[4] Twidale, C.R. and E.M. Campbell, 2005. *Australian Landforms: Understanding a Low, Flat, Arid and Old Landscape*, Rosenberg Publishing Pty Ltd, New South Wales, Australia, p. 153.
[5] Blair, W.N. and Armstrong, A.K., 1979. Hualapai Limestone Member of the Muddy Creek Formation: the Youngest Deposit Predating the Grand Canyon, Southeastern Nevada and Northwestern Arizona, *U.S. Geological Survey Professional paper 1111*, U.S. Government Printing Office, Washington, D.C.
[6] Dicke, S.M., 1985. Stratigraphy and sedimentology of the Muddy Creek Formation, southeastern Nevada, M.S. thesis University of Kansas, Lawrence, KS.

Hualapai Formation. It is exposed in the Lake Mead area as erosional remnants left from a much larger area (Figure 10.1). It is dated as late Miocene or the middle part of the late Cenozoic by uniformitarian scientists. It not only forms thick masses, but also is inter-bedded with other types of rocks, such as conglomerates and sandstones of the Muddy Creek Formation.[7] The Muddy Creek Formation has been considered an interior basin deposit within the continent.[8] However, some scientists believe that it was deposited in brackish water during a marine incursion from the Gulf of California up into the Las Vegas areas.[5,9] This interpretation is still equivocal among some scientists.[10,11]

Figure 10.1. Outcrops of the Haulapai Limestone Member of the Muddy Creek Formation in the Lake Mead area (drawn by Mrs. Melanie Richard).

The Hualapai Limestone occupies topographic lows between uplifted mountains. It is over 1,000 feet (300 m) deep and is remarkably pure.[12] However, others think the limestone is impure,[13] which means that it may depend upon the location. The volume of the current mass of limestone is over 40 mi^3 (100 km^3),[14] but its original volume could have been many times this

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[7] Young, R.A., 2008. Pre-Colorado River drainage in western Grand Canyon: potential influence on Miocene stratigraphy in Grand Wash Trough; in: Reheis, M.C., Hershler, R. amd Miller, D.M. (Eds.), *Late Cenozoic Drainage History of the Southwest Great Basin and Lower Colorado River Region: Geologic and biotic Perspectives*, GSA Special paper 439, Geological Society of America, Boulder, CO, pp. 319–333,
[8] Hunt, C.B., 1956. Cenozoic Geology of the Colorado Plateau, *U.S. Geological Survey Professional paper 279*, U.S. Government Printing Office, Washington, D.C.
[9] Blair, W.N., 1978. Gulf of California in Lake Mead area of Arizona and Nevada during Late Miocene time, *AAPG Bulletin* 62:1,159–1,170.
[10] Bohannon, R.G., 1984. Nonmarine Sedimentary Rocks of Tertiary Age in the Lake Mead Region, Southeastern Nevada and Northwestern Arizona, *U.S. Geological Survey Professional paper 1259*, U.S. Government Printing Office, Washington, D.C., pp. 55, 56.
[11] House, P.K., Pearthree, P.A., Howard, K.A., Bell, J.W., Perkins, M.E., Faults, J.E., and Brock, A.L., 2005. Birth of the lower Colorado River—Stratigraphic and geomorphic evidence for its inception near the conjunction of Nevada, Arizona, and California; in: Pederson, J. and Dehler, C.M. (Eds.), *Interior Western Unites States: GSA Field Guide 6*, Geological Society of America, Boulder, CO, pp. 357–387.
[12] Hunt, Ref. 8, pp. 33, 35.
[13] Bohannon, Ref. 10, pp. 1–72.
[14] Blair and Armstrong, Ref. 5, p. 12.

volume since much of it has been eroded. The limestone contains various types of fossils, including plant fossils of grasses, reeds, and rushes, and this is one reason why scientists have proposed a terrestrial environment. Chert is inter-bedded within the limestone, which is a common occurrence in Paleozoic limestones, such as the Kaibab Limestone at the top of the Grand Canyon (Figure 10.2). The Hualapai Limestone is also fine-grained, which suggests inorganic precipitation in water, but the limestone is believed to have been generated from organisms because that is the type of carbonate predominantly deposited today,[15] which is part of the uniformitarian belief system that present processes interpet the past.

Figure 10.2. Chert nodule in the Paleozoic Kaibab Limestone at the top of the North rim of Grand Canyon.

Large Volume Carbonates Very Likely Deposited in the Flood

Regardless of whether this limestone is marine, brackish, or freshwater, its deposition after the Flood on the continents is questionable, since significant inorganic limestone is not being precipitated today. Limestone deposited after the Flood should contain significant other sediments, no matter whether deposited in a lake, brackish water, or the ocean, but most Cenozoic limestone is pure. Carbonates should also be thin after the Flood, while they are commonly thick in the Cenozoic. Where would the carbonate originate after the Flood? Could it be from erosion of limestone formations? If that were the case, the limestone would be well

[15] Blair and Armstrong, Ref. 5, p. 9.

mixed with other sediments. Moreover, the top of the Hualapai Limestone has been eroded, so not only do advocates of post-Flood catastrophism need to find a way for the limestone to be deposited; they also need to erode off the top. This sequence is similar to the basin fills of the Rocky Mountains (see Chapter 5).

It seems as though it would be impossible to form relatively thick, widespread, generally pure carbonates on the continents after the Flood. Such carbonates are more likely a Flood formation, similar to the many other limestones older than the Cenozoic. Therefore, the Flood/post-Flood boundary would be above the limestone layer, which for the Lake Mead area would be in the very late Cenozoic.